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ABSTRACT

This scope and sequence guide, developed for an aircraft mechanics vocational education program, represents an initial step in the development of a systemwide articulated curriculum sequence for all vocational programs within the Metropolitan Nashville Public School System. It was developed as a result of needs expressed by teachers, parents, and the business community for sequential structure within the vocational education curriculum. The guide contains an introduction, course description, general course objectives, course content (with specific objectives) in outline format, and a list of resource materials, such as textbooks, curriculum guides, and audiovisual aids. This two-year course offers an opportunity for students to develop skills and technical knowledge that will enable the competent graduate to secure work in the aircraft industry. The course covers the principles of aerodynamics and their application to different types of aircraft. Other areas covered are airframe construction; controls and instruments, their function and maintenance; the theory of electricity, electronics, hydraulics, pneumatics and mechanics as applied to aircraft function and maintenance; and the properties and characteristics of parts and materials used in aircraft construction. The knowledge and skills developed in the aircraft mechanics course can provide a background for students who plan a career in flying or aeronautical engineering. (KC)

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ED267207

AIRCRAFT MECHANICS

SCOPE AND SEQUENCE

VOCATIONAL EDUCATION

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Metropolitan Public Schools

Nashville Davidson County, Tennessee

Charles O. Frazier, Director

FOREWORD

This scope and sequence guide, developed for the Aircraft Mechanics Vocational Education program, represents an initial step in the development of a systemwide articulated curriculum sequence for all vocational programs within the Metropolitan Nashville Public School System. It is a direct result of needs expressed by teachers, parents, and the business community for sequential structure within the vocational education curriculum. An articulated vocational curriculum allows a student to move from one level of instruction to the next without repeating learning tasks already mastered, and without experiencing gaps in the presentation of relevant instructional material.

A goal of this curriculum effort is to provide teachers a usable guide based on input from the teachers. The initial step was an identification of course content, with all teachers having an opportunity to contribute. What follows is a publication using the teachers' contributions: a sequential listing of objectives and skills for each program offering.

This guide does not include all specific resource materials that may be used to assist students in acquiring minimum competencies. It is to serve as a guide for the sequence of course content and scope of what is to be taught. This guide content is extremely important and its use is encouraged. The suggested competencies and resource materials allow instructors an opportunity to be creative and resourceful in meeting the needs of individual programs and students.

ACKNOWLEDGEMENT

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The Committee:

Instructors	Schools
Ray Mitchell	McGavock

Committee Coordinator: Preliminary Committee and Revision Committee-Ray Mitchell-McGavock

Program Area: Forrest P. Wilson

Editorial Consultant/Design/Layout

Judy Beier - Commerical Art Instructor - Maplewood
Mary Jo Grady - Commercial Art Instructor - Pearl/Cohn
Joy Binkley - Editing
Dr. Jim Lorenz - Third Party Evaluator
Exemplary Project Staff
Vocational Program Coordinators

Printing/Binding/Typesetting/Technical Assistance

Sam White - Printing Instructor - Overton
Jesse Ray - Printing Instructor - Whites Creek
Cleve Yokely - Printing Instructor - Stratford
Kenneth Ford - Manager - Metropolitan Public School Binding
Robert Tucker - Director - Metropolitan Public School Printing Department
Jean Porter - Publications Specialist - Department of Communication and Community Relations
Debbie Fulghum - Typesetter - Department of Communication and Community Relations

INTRODUCTION

The course in Aircraft Mechanics offers an opportunity for the development of skills and technical knowledge which will enable the competent graduate to secure work in the aircraft industry. Upon passing tests required by the Federal Aviation Administration (FAA), a graduate may be certified as an Airframe and Powerplant Mechanic.

Knowledge and skill developed in the Aircraft Mechanics course provide an excellent background for the student who plans a career in flying or Aeronautical Engineering.

COURSE DESCRIPTION

Aircraft Mechanics includes the principles of aerodynamics and their application to different types of aircraft. Other areas covered are: airframe construction, controls and instruments, their function and maintenance; the theory of electricity, electronics, hydraulics, pneumatics and mechanics as applied to aircraft function and maintenance; the properties and characteristics of parts and materials used in aircraft construction.

GENERAL COURSE OBJECTIVES

1. To teach safety procedures in aircraft mechanics
2. To teach proper care and use of tools and equipment used in aircraft mechanics
3. To insure that students are knowledgeable of theory, design and construction of airframes, powerplants and accessories
4. To teach overhaul, repair and troubleshooting of aircraft systems, powerplants and accessories
5. To teach the operation and testing of aircraft systems, powerplants and accessories
6. To inform students regarding aviational progress, and the operation and work of the Federal Aviation Administration (FAA)
7. To stress the importance of using trade papers and professional journals
8. To stress the importance of airframe and powerplant reliability

COURSE CONTENT FOR AIRCRAFT MECHANICS I

(First Semester)

I. Orientation (6 weeks)

Specific objectives:

To become familiar with the rules of the school and shop procedure
To learn to be aware of the hazards of working around aircraft
To learn the proper use of safety equipment and hand tools

A. Learns rules and regulations

1. Schedule
2. School regulations
3. Facilities

B. Learns safety principles and precautions

1. Safety procedures
2. Shop safety
3. Good working habits
4. Safety with tools
5. Types of fires--location of fire bottles
6. Safety with air hoses
7. Protective equipment

C. Uses aircraft and powerplant tools

1. Nomenclature
2. Types
3. Sizes
4. Care

I. **Orientation continued:**

D. Completes phase test

II. **History of aviation, aerodynamics and theory of flight (6 weeks)**

Specific objectives:

To learn about the development of the airplane
To learn flight control systems and the forces which act upon an aircraft in flight

A. Learns classification and nomenclature of aircraft

1. Aircraft classification
2. Aircraft types
3. Aircraft designation
4. Principle structural units

B. Understands fundamentals of rotational motions and stress

1. Rotational motions
   a. Vertical
   b. Longitudinal
   c. Lateral
2. Stresses

C. Studies aircraft control systems

1. Primary group
2. Secondary group
3. Miscellaneous group

D. Studies aerodynamics

1. Atmosphere
2. Flight

D. Studies aerodynamics continued:

3. Law governing flight

4. Pressure differential

5. Forces acting on an aircraft in flight

E. Studies airfoils

1. Classification

2. Airfoil selection

F. Completes phase test

III. Weight and balance (6 weeks)

Specific objectives:

To learn how to weigh an aircraft
To accurately compute the findings mathematically and make proper log book entries

A. Studies weight and balance

1. Terminology

a. Tare

b. Center of gravity

c. Datum

d. Useful load

e. Empty weight

f. Maximum weight

2. Use of proper forms

B. Studies weighing aircraft

1. Aircraft preparation for weighing

a. Purpose

1. Aircraft preparation for weighing continued:
    b. Procedure
    c. Safety precautions
2. Equipment list
    a. Removable
    b. Stationary
3. Weighing aircraft
    a. Level flight position
    b. Effects of tare
    c. How to read scale
    d. Effects of wind
    e. How to measure arms

C. Learns other computations
1. Use of aircraft specifications
2. Plus and minus moments
3. Forward and rearward
4. Exceeding conditions
5. Ballasting
6. Baggage consideration
7. Empty weight
8. Fuel and oil weight
9. Loading schedule
10. Fuel restrictions

D. Completes phase test

COURSE CONTENT FOR AIRCRAFT MECHANICS I

(Second Semester)

I. **Aircraft construction materials--properties and characteristics of aircraft metals (6 weeks)**

Specific objective:

To learn how to identify and use the different types of aircraft structural materials and hardware

A. Studies forms and shapes of metals

1. Aluminum
2. Magnesium
3. Steel tubing hose
4. Clamps and fittings

B. Classified nuts, bolts, fasteners and inserts

C. Studies control cables, turn buckles and control rods

D. Uses safety precautions

1. Purpose
2. Methods

E. Completes phase test

II. **Inspection methods of metals (6 weeks)**

Specific objectives:

To learn the different methods of inspection and the proper use of precision measuring instruments

A. Magnaflux

B. Zyglo

II. **Inspection methods of metals continued:**

C. Uses dy-check

D. Studies measuring instruments

E. Completes phase test

III. **Publications (6 weeks)**

Specific objectives:

To learn the importance of using technical publications when working on aircraft
To learn the different types of inspections required by law and who may perform these inspections

A. Learns mechanics privileges and limitations

1. Purpose

2. Origin

3. Contents

4. Format

5. Records

B. Uses aircraft log records

1. Log books

2. Accessory records

3. Equipment service records

C. Studies technical operation and maintenance manuals

1. Purpose

2. Uses

3. General types

a. Aircraft

(1) Operational manuals

a. Aircraft continued:

(2) Maintenance manuals

b. Structural

(1) Repair manuals

(2) Miscellaneous catalog

(3) Parts catalog

D. Studies major repair and alteration

E. Studies Federal Aviation Regulations

1. Airworthiness directives

2. Annual inspections

3. 100 hour inspections

4. Major repair and alterations

5. Progressive inspections

6. Malfunctioning and defects

7. Specifications

F. Detailed study of Federal Aviation Regulations part 65 and AC 43-13-1 and 2

G. Completes phase test

COURSE CONTENT FOR AIRCRAFT MECHANICS II

(First Semester)

I. **Wood structures (6 weeks)**

Specific objective:

To learn how to identify, inspect, manufacture, repair and finish aircraft wood structures

A. Studies wing nomenclature

B. Studies wing rib layout

C. Makes a rib jig

1. Materials

2. Tools

3. Procedure

4. Blocking in

D. Splices wood ribs

1. Reinforcement plates

2. Splicing box spar webs

E. Finishes wood structures

1. Precautions

2. Finishing interior and exterior surface

3. Finishing with fabric or tape

F. Completes phase test

II. **Aircraft covering (9 weeks)**

Specific objectives:

To learn how to apply synthetic and organic fabric on aircraft

Specific objectives continued:

To learn to perform minor and major repairs on fabric covered structures

A. Identifies materials

1. Textile terms
2. Approved specifications
3. Tape and webbing
4. Thread and cord
5. Hardware

B. Applies fabric covers

1. Doping fabric
2. Seams
3. Hand sewing rules
4. Covering preparation

C. Knows types of wing covers

1. Envelope
2. Blanket method
3. Lock knot
4. Fabric fasteners
5. Lacing fabric to structure

D. Identifies applying accessories

1. Number required
2. Types
3. Purpose
4. Method of installation

E. Makes fabric repairs

1. Limitations

a. Size

b. Aircraft speed

2. Method of installation

3. Materials

F. Completes fabric testing

1. Types

2. Function

3. Purpose

G. Completes phase test

III. **Aircraft finishing (3 weeks)**

Specific objectives:

To learn how to properly identify and apply the different types of paint lacquer and dope used for aircraft finishing
To install identification numbers and placards in accordance with federal regulations

A. Studies aircraft dope and paint

1. Uses

2. Types of finishes

a. Cellulose nitrate dope

b. Cellulose accetate butyrate dope

c. Synthetic enamels

d. Lacquers

3. Application methods

a. Brush

3. Application methods continued:

b. Gun

4. Minimum coats required

B. Uses solvents thinners, finishes

1. Alcohol

2. Toluene

3. Linseed oil

4. Zinc chromate

5. Paint and dope thinners

C. Applies finishes

1. Operation of gun

2. Finishing troubles

3. Use of brushes

D. Applies numbers and placards

1. Height specifications

2. Width

3. Spacing

4. Color

5. Position

6. Stencils

E. Completes phase test

COURSE CONTENT FOR AIRCRAFT MECHANICS II

(Second Semester)

I. Aviation sheet metal (12 weeks)

Specific objectives:

To learn how to identify the different types of metals used in aircraft structures
To learn how to fabricate aluminum structures
To learn how to select and install aircraft rivets
To learn the proper use of aircraft riveting tools and equipment

A. Studies properties of metals

1. Ferrous

a. Cast iron

b. Mild steel

c. Alloy steel

2. Nonferrous metals

a. Copper

b. Brass

c. Magnesium

d. Aluminum

e. Titanium

B. Uses tools for metal work

1. Aviation hand tools

2. Equipment for cutting

a. Aviation snips

b. Squaring shears

2. Equipment for cutting continued:

c. Hand bench shears

d. Turret punch

C. Selects rivets

1. Types

2. Identification marks

3. Head shapes

4. Heat treated, non-heat treated

5. Limitations

a. Exterior

b. Interior

c. Structural

D. Studies riveting principles

1. Diameter and length

2. Rivet spacing

3. Rivets for splices and single lip joints

E. Uses riveting equipment

1. Pneumatic riveters

2. Squeeze riveters

3. Rivet gun selection

4. Drilling holes

5. Portable drills

6. Skin fasteners

7. Counter sink

F. Fabricates aluminum structures

1. Proper type of metal

2. Lay out with proper tools

3. Purpose and technique of using proper tools

4. Aircraft sheet metal blueprint reading

G. Repairs trailing edges and control surfaces

1. Determine damage to parts

2. Select stock

3. Repair

4. Manufacturers specifications

5. Weight and strength of materials

6. Flutter precautions

a. Ailerons

b. Tail surfaces

H. Completes phase test

II. **Rigging and assembly (3 weeks)**

Specific objectives:

To learn how to rig and adjust flight control systems on fixed wing and rotor craft

A. Studies equipment, instruments, tools required and their use

B. Studies aircraft controls and surfaces

1. Assembly

2. Rigging

3. Service

4. Repair

B. Studies aircraft controls and surfaces continued:

5. Adjustment

6. Inspection

7. Aerodynamic consideration to be observed in aircraft controls when rigged or adjusted

C. Studies the assembly and rigging of rotary wing aircraft

1. Rotating air foil nomenclature

2. Flight controls

3. Flight conditions

D. Studies cyclic pitch

1. Purpose

2. Description

3. Operation

E. Studies collective pitch control system

1. Purpose

2. Description

3. Operation

F. Studies tail rotor system

1. Purpose

2. Components

3. Operation

G. Completes phase test

III. **Hydraulic, pneumatic and landing gear systems (3 weeks)**

Specific objectives:

Specific objectives continued:

To become familiar with the basic principles of fluids in motion
To learn the different types of hydraulic and pneumatic systems
To learn the repair and maintenance of fixed and retractable landing gear systems
To learn the care and service of wheels and brakes

A. Studies fundamentals of aircraft hydraulics

1. Characteristics
2. Hydraulic principles
3. Development of a basic hydraulic system
4. Power pumps
5. Hand pumps
6. Actuating units
7. Reservoirs, filters and accumulators
8. Hydraulic fluids
9. Hydraulic packing rings (seals)
10. Sequence valve
11. Shuttle valve
12. Crossflow valves
13. Selector valves (general)
14. Rotor-type selector valves
15. Poppet-type selector valves
16. Piston-type selector valve
17. Open-center system selector valve
18. Kickout adjustments
19. Follow-up selector

A. Studies fundamentals of aircraft hydraulics continued:

20. Solenoid selector valves

21. Limit switches

B. Studies type of control valves

1. Pressure regulators

2. Power control valves

3. Pump control valves

4. Time-lag power control valves

5. Relief valves

6. Pressure cutoff valves

7. Flap overload valves

8. Ratchet valves

9. Hydraulic pressure switches

10. Pressure-gauge snubbers and surge restrictors

C. Studies aircraft hydraulic systems, inspection, servicing, adjustment

1. Classification of hydraulic systems

2. Electrically driven pump system

3. Power control valve system

4. Pump control valve system

5. Pressure regulator system

6. Direct pressure system regulated by relief valve

7. Direct pressure system regulated by unloading valve

8. Direct pressure system regulated by a power control valve

9. Direct pressure system regulated by a variable delivery pump

C. Studies aircraft hydraulic systems, inspection, servicing, adjustment continued:

10. Open-center system
11. Open-center combined with direct pressure system
12. High-pressure hydraulic systems
13. Pneumatic systems

D. Analyzes installation, identification and replacement of lines and fittings

1. Plumbing installation
2. Color coding
3. Causes for replacement of lines and fittings

E. Studies classification of landing gear

1. Preliminary explanation
2. Main landing gear—types and operation
3. Auxiliary landing gear
4. Nose gear and tail bumper
5. Shimmy dampers and shock struts
6. Steering mechanism

F. Studies retractable landing gear

1. Construction of shock struts
2. Main gear
3. Nose gear
4. Light airplane gear
5. Modern applications

III. **Hydraulic, pneumatic and landing gear systems continued:**

G. Studies care of tires

1. Preliminary explanation
2. Storing
3. Installation
4. Inflating
5. Inspection
6. Regular maintenance
7. General care

H. Studies shimmy dampers

1. Purpose
2. Construction
3. Operation

I. Studies shock absorbers

1. Purpose
2. Types
3. Simple shock strut construction
4. Tires and shock absorbers
5. Complicated strut construction
6. Shock-strut operation

J. Studies wheels

1. Types
2. Materials
3. Wheel construction

J. Studies wheels continued:

4. Main landing gear wheels

5. Auxiliary landing gear wheels

6. Grease and bearing retainers

K. Studies brakes

1. Classification of brakes

2. Internal expanding-shoe brakes

3. Disc type brakes

4. Expander tube brakes

5. Anti-skid brakes

L. Completes phase test

COURSE CONTENT FOR AIRCRAFT MECHANICS III

(First Semester)

I. **Powerplant principles (2 weeks)**

Specific objectives:

To learn basic engine principles and theory
To learn the systems required for powerplant operation and how they function

A. Studies aircraft engine development

1. History
2. Definition
3. Types
4. Designation

B. Studies combustion engine operation

1. Two stroke cycle
2. Four stroke cycle
3. Systems
   a. Induction
   b. Cooling
   c. Lubrication
   d. Fuel
   e. Ignition

C. Analyzes engine power and power measurement

1. Piston displacement
2. Compression ratio

C. Analyzes engine power and power measurement continued:

3. Horsepower

4. Performance

D. Studies fundamentals of powerplant requirements and construction

1. In-line

2. V type

3. Opposed

4. Radial

E. Completes phase test

II. **Lubrication, fuel, fuel systems and induction systems (4 weeks)**

Specific objectives:

To become familiar with the types and grades of aviation fuels and lubricants
To learn how to inspect, maintain and repair fuel and oil systems

A. Analyzes oil and lubricants

1. Types

2. Grades

3. Properties

B. Studies lubrication systems

1. Dry sump

2. Wet sump

3. Splash

4. Pressure

5. Instruments

6. Pressure and temperature

II. **Lubrication, fuel, fuel systems and induction systems continued:**

C. Studies pumps

1. Types
2. Installation
3. Location
4. Operation
5. Construction
6. Maintenance
7. Repair
8. Inspection

D. Studies Lines

1. Installation
2. Care
3. Inspection

E. Studies hose connections

1. Installation
2. Care
3. Inspection

F. Studies tanks

1. Installation
2. Care
3. Inspection

G. Studies drains

1. Installation

G. Studies drains continued:

2. Care

3. Inspection

H. Studies vents

1. Installation

2. Care

3. Inspection

I. Studies filters

1. Installation

2. Care

3. Inspection

J. Studies heating and cooling

1. Radiators

2. Lagging

3. Installation

4. Maintenance

5. Repair

6. Inspection

K. Completes phase test

III. Carburetion (4 weeks)

Specific objectives:

To learn the theory of carburetion
To learn how to inspect, adjust and repair float carburetors, pressure carburetors and fuel injection systems

A. Identifies and studies theory and principles of carburetion

A. Identifies and studies theory and principles of carburetion continued:

1. Carburetors and fuel injection

a. Types

b. Construction

c. Operation

d. Inspection

e. Installation

f. Maintenance

(1) Adjustment

(2) Repair

B. Studies FAA regulations on float and pressure carburetors, privileges and limitations on carburetor maintenance and overhaul

IV. Electrical (6 weeks)

Specific objectives:

To learn basic electricity to maintain and repair magnetos, starters, generators, batteries and spark plugs
To learn proper use of test equipment

A. Studies theory of basic electricity

1. Magnetism

2. Nomenclature

3. Related terms

4. Calculation of series, parallel, series-parallel circuits

5. Selection of wires, cables, fuses and circuit breakers

6. FAA requirements pertaining to electrical alterations

A. Studies theory of basic electicity continued:

7. Construction and use of continuity test equipment, voltmeters, ammeters, ohmeters, units, circuits, circuit breakers and fuses

8. Installation of and precautions to be followed in removing and replacing

B. Compares aircraft batteries

1. Types

2. Theory

3. Capacity

4. Maintenance

5. Charging

6. Installation

C. Studies aircraft starters

1. Types

2. Theory

3. Principles

4. Overhaul procedure

5. Electrical hookup

6. Motor operation

7. Maintenance

8. Troubleshooting

D. Studies magneto ignition

1. Types

2. Theory

D. Studies magneto ignition continued:

3. Principles

4. Overhaul

5. Maintenance

6. Troubleshooting

E. Compares ignition harness

1. Types

2. Theory

3. Maintenance

4. Troubles

5. Testing

F. Compares spark plugs

1. Types

2. Theory

3. Maintenance

4. Installation

5. Troubleshooting

G. Studies booster systems

1. Types

2. Electrical hookup

3. Operation

4. Installation

H. Studies battery ignition system

1. Principles

H. Studies battery ignition system continued:

2. Function

I. Completes phase test

V. Propellers and propeller systems (2 weeks)

Specific objectives:

To learn propeller fundamentals
To learn the care and maintenance of fixed pitch, constant speed, controllable and hydromatic propellers

A. Studies general information on propellers

1. Definition
2. Stress
3. Specifications
4. Theory
5. Development
6. Rating
7. Marking

B. Identifies types of propellers

1. Fixed pitch
2. Ground adjustable
3. Controllable
4. Constant speed
5. Hydromatic
6. Electric

C. Studies systems of propellers

1. Synchronization

C. Studies systems of propellers continued:

2. De-icing and anti-icing

3. Feathering and reversing

D. Completes phase test

COURSE CONTENT FOR AIRCRAFT MECHANICS III

(Second Semester)

I. Overhaul and operation of four and six cylinder opposed engines (12 weeks)

Specific objective:

To learn how to overhaul, test and return to service aircraft engines, using special tools, service manuals, parts catalogs and FAA publications

A. Studies practices and procedures of aircraft engines service

1. FAA and manufacturer reference listing requirements
2. Shop safety and cleanliness
3. Handling of parts
4. Use of tools and equipment

B. Analyzes forms and logs

C. Practices removal and cleaning

1. Methods of cleaning
2. Types of cleaners

D. Practices dissassembly and cleaning

E. Studies inspection processes

1. Precision instruments
2. Magnetic particle
3. Penetrant

F. Practices approved repair procedures

1. Rebushing engine
2. Valve guide replacement
3. Stud replacement

I. **Overhaul and operation of four and six cylinder opposed engines continued:**

G. Applies assembly processes

1. Accessory installation
2. Torque valves
3. Timing installations
4. Inspection

H. Applies installation and inspection procedures

I. Performs operational testing

J. Completes forms and logs as applicable

K. Prepares engine for storage

1. Clear gas run
2. Preservation procedures and materials

L. Completes phase test

II. **Jet propulsion powerplants and line maintenance (6 weeks)**

Specific objective:

To learn the principles of jet propulsion, construction and operation of turbojet and turboprop engines

A. Studies basic principles of jet propulsion

1. Newton's laws of motion
2. Performance characteristics
3. Types of jet propulsion powerplants
4. Theory of operation
5. Basic construction of turbojet (centrifugal and axial flow) and turboprop engines

II. **Jet propulsion powerplants and line maintenance continued:**

B. Performs general servicing

1. Fueling
2. Refueling equipment
3. Engine run-up

C. Analyzes troubleshooting processes

1. Centrifugal flow engines
2. Axial flow engines

D. Studies and performs inspections

1. Daily
2. 25 hour
3. 100 hour
4. Periodic or progressive
5. Special inspection

E. Completes phase test

RESOURCE MATERIALS

Textbooks

Bent/McKinley. Aircraft Maintenance and Repair, Fourth edition. McGraw-Hill, 1980.

Bent/McKinley. Aircraft Powerplants, Fourth edition. McGraw-Hill, 1978.

Curriculum Guides

National Study of Aviation Mechanics Occupation, Government Printing Office (G.P.O.), 1970.

Audio Visual

Filmstrip (Dukane)

Careers in Aviation
Aviation History
Science of Flight
Airplane Systems and Instruments
Fuel Metering Systems
Aircraft Propellers and Controls
Aircraft Reciprocating Engines
Aircraft Ignition Systems
Wood Working Power Tools
Wood Work Finishing
Single Engine Electrical Systems
Spark Plug Care and Combustion Analysis
400/600 Series Magnetos
Centurion (210K) Hydraulic Landing Gear System
Continental Fuel Injection System
Flight Line Service
Turbo Charger Systems

8 MM Film Loops

How to Read a Micrometer
How to Read a Vernier Scale

Audio Visual continued:

Transparencies

Wood Technology
Engine Principles
Engine Designs
Oil Systems
Fuel Systems
Aircraft Hardware
Flight Control Systems
Blue Print Reading
Weight and Balance
Magnetos